Management of Innovation in Engineering - Fall 2018 - APS1012H-S-LEC 020 –100% starting week begin 10th Sept 2018. There is only one inclass session –??th Sept 2018 (Room ??). Please refer to announcements on course web site (BB) for schedules.

Course Outline

“Science aims to understand nature and engineering, is about creating what has never been”. Theodore von Kármán

Innovation is the transformation of knowledge into products, processes, and services and is critical to economic competitiveness, long-term productivity growth, and wealth creation. Since the beginning of the industrial revolution in the 18th century Engineers emerged as the key drivers of national and international innovation and quality of life. By the middle of the 19th century engineering began to professionalize around functional disciplines that where designed around the underlying engineering science. Currently powerful forces, including demographics, globalization, and rapidly evolving technologies are dramatically changing the nature of engineering practice demanding far broader more integrative skills than simply the mastery of scientific and technological disciplines. 21st century challenges consist of complex system problems including transportation, communication, security, aging population, energy production and distribution, environmental remediation and sustainability. The 21st century engineering profession must transition toward a model built on discovery, innovation and entrepreneurship. This will require Engineers to move beyond the traditional foundation in pure sciences, mathematics, and engineering sciences to be drivers of strategic innovation and policy formation – in a nutshell to “Engineer” strategic change. The “Management of Innovation” course will provide students with the core concepts of innovation including; strategic thinking, transformational change management, design & development of an innovative enterprise, and sustaining a culture of innovation. This seminar style course will equip students with the knowledge and the skills to manage innovation at strategic and operational levels. The management of innovation is interdisciplinary and multi-functional, requiring the alignment of market forces, technological systems and organizational change to improve the competitiveness and effectiveness of organizations and society. We shall argue that the process of innovation management is essentially generic, although organization, technological and market specific factors will require tailoring direction and actions. This course will incorporate both academic readings to provide the broad theory of innovation but most of the readings and discussion will be based on the instructors many years of hands on practical experience in the management of innovation in a variety of industry sectors.

- There are two books for the course that are not mandatory but can serve as common core reading each week: 1) Engineering and Product Development Management – The Holistic Approach (Cambridge University Press, 2001), and 2) Sustaining Continuous Innovation Through Problem Solving (Industrial Press, New York 2008) – this book will also be the main reading for the Applying Innovation course APS1013. Full disclosure: I wrote both of these books. For each module students will read the common reading (in bold type). The core chapter readings for each week are provided below for each module. The course has been structured around both
books and the requirement to read and comment each week is extremely important in the online class.

Other books available online that we will review are:

- Morris, Langdon; Permanent Innovation: Innovation Labs LLC 2006, E Library

Downloaded from Blackboard - Module 0

There are no mandatory prerequisites but previous course work or experience in leadership, process management, project management, continuous improvement (six sigma, lean), strategic management, organizational change management, lean product development or operations management would be helpful.

Important Expectations of Online Students

Online learning is not home study. It requires as much or more effort than in class learning – the advantage being – you get to engage in the learning experience at a time you choose. The academic rigor and learning outcomes are identical to an in class experience. The online course will be administered via blackboard therefore use of blackboard is mandatory. There are some baseline rules that online learning requires. Students:

- Must commit and engage in online discussion from the end of the first week. Marks for online discussion are included in the mid term and final critical review papers.
- Must read and understand the student performance evaluation rubric and demonstrate this by discussing how it works in blackboard by the end of the 2nd week.
- Provide (optional) a 2-minute background introduction video by the end of the 2nd week – just to demonstrate the use of video and drop box. Written introduction mandatory.
- Will be expected to produce one 4-6-minute video - to self assess the mid term critical review.
- Understand a lack of engagement in the discussion board evenly paced throughout the course will inhibit your ability to write the critical review papers. Each lecture and discussion board will be posted for 2 full weeks and then locked (can read but not write). This means online blackboard discussions on the lectures must be completed in an even flow through the course – you can’t build them up. This would inhibit the learning experience

Course Objectives

Upon course completion, the participants will be able to:

- Establish a context for Innovation and its dimensions
- Analyze the elements of Innovation management as a key organizational capability
- Explain how innovations are diffused across cultures
- Identify how to develop an innovative future state vision through systems thinking
- Develop and prepare an organization for an innovation transformation initiative
- Explain and assess a culture of innovation for readiness to change
- Identify how to overcome the barriers to innovation in organizations
- Develop the key leadership roles in managing innovation at the group/department, division, and corporate levels
- Develop an integrated enterprise approach to innovation
- Design an Innovation delivery system for various environments
- Apply process management and project management practices to product development
- Organize and develop integrated Project / Product teams (IPT’s) for project execution
- Deploy and Embed an innovation process through the core culture
- Continuously assess the “As Is” business processes
- Continuously improve the “As Is” process through structured problem solving
- Apply the key strategies to engage the people to sustain an innovative culture
- Identify challenges in measuring and maintaining innovation performance

Course Structure and Content: Managing Innovation is divided into four themes and 12 modules:

- The first theme is establishing a context for Innovation that will include numerous case histories of companies managing certain types of technological change. We will discuss various kinds of innovation and innovation diffusion through the ages.
- The second theme is; Design and Developing an Innovative Enterprise. The sources of success for great companies lie in what they do very well. The business model that has created great success can also be a barrier to change, as well as a source of advantage. Disruptive Technologies fundamentally challenge the company’s current state business model – which is why they are so disruptive. We will discuss the approach to transformational change including visioning, process management, overcoming resistance to change, systems thinking, and effective teams

- The third theme examines; Building the Innovation Management Process. Once we understand how to overcome the barriers to change, we must then find out how companies can organize to achieve an innovative culture that can deliver the value proposition. We will examine how to design an innovative process management system that allows a company to design and build products more effectively and launch new products effectively. We will examine enterprise processes in variety of industry sectors (Aerospace –Military and Commercial, Food, Machinery, Newspapers). We will examine the integration of project management techniques with process management.

- The fourth theme considers; Sustaining the Innovative Lean Enterprise. Once we understand how to overcome the barriers to change, we must then find out how companies can sustain an innovative culture. We will examine how to continuously analyze and improve business processes and business models. Central to achieving this culture is to embed systematic problem solving at the heart of day-to-day operational activities.

Learning outcomes

Knowledge and Comprehension:
- Understand the central features of the management of innovation at the operational and strategic levels, specifically the relationships between market, technological and organizational change, and how it contributes to the competitiveness of firms.
- Explain the various parts of the innovation process and their interaction

**Intellectual Skills (Analysis and Synthesis)**
- Students will develop an integrated framework for strategic thinking to analyze the process of innovation in a wide range of organizational, technological and market contexts.

**Practical Skills (Application and Evaluation)**
- Students will develop the awareness of the application of innovation methodologies to assess and improve organizations
- Assess the likely success of innovation initiatives in various organizations
- Be able to think, write and communicate critically

**Course Grading:** The components of the final course grade will be weighted as follows:

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<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tr>
<td>Discussion Board Contribution (10 out of 12) – provides breadth in knowledge</td>
<td>30%</td>
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<tr>
<td>Mid Term Critical Review (CR1) Paper (based on discussions Mods 1-6)</td>
<td>15%</td>
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<td>One 4-6 minute video that critiques your mid term CR using the Rubric</td>
<td>10%</td>
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<tr>
<td>Final Critical Review (CR2) Paper (based on discussions in Mods 7-12)</td>
<td>15%</td>
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<tr>
<td>Project Team Report– (Charter - 5%) (PPT Summary – 5%)</td>
<td>30%</td>
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**Class Participation – Online Discussions.** This course will be offered online only for the Fall 2018. The course will be taught through a combination of video lectures (45-70 minutes), scholarly readings, and online discussion. **Use the online discussions input to form your critical review papers. Discussion board contribution can earn 30% -** you will be given an overall grade for the discussions against the performance rubric.

**Critical Review Papers.** There are a total of 2 critical review papers (mid term and final) required from each student. These papers allow you to focus on depth of knowledge. The marks are 20% each. Students will post critical review papers on the discussion board. Both critical reviews will be written papers (1200-1500 words) and the mid term paper will include a 4-6 minute verbal self-critique delivered via video – use drop box. The CR’s should be formed around the input in the discussion board. The idea is that you produce a CR that **summates your learning and reflections from the online discussions.** So for the mid term you will synthesize modules 1-6 and for the final CR you will synthesize Modules 7-12.

**Final Paper - Project Report.** Depending on the class size students may form teams and produce a team report. Whether in a virtual team environment or as an individual the level of effort is the same. For the final paper you are free to select a topic in innovation that interests you. The goal of the final project report is **not** to do original field research, but to demonstrate to me your ability to apply innovation concepts in a situation of your choosing. The final report should be double-spaced, 12 point font, (approximately 1200-1500 words per student). Timing is very important to Managing Innovation! **A hard copy and a soft copy of the paper** (using
Microsoft Word, NOT an Adobe Acrobat PDF!) must be delivered by email no later than 14th Dec 2018 by midnight to my email address, stephenc.armstrong@utoronto.ca - the hard copy to be given to the mechanical & industrial engineering graduate office 14th Dec 2018 by 4pm

Please note: for guidance purposes summaries of the team project reports from the 2010 to 2017 classes are available on blackboard in Module 0 – under content.

Office Hours. Not applicable

Important Dates (Approx – Use Announcements in Quercus Portal):
- 10th Sept 2018 (6-8PM SF1101) – Mods 0 &1 Live Inclass: Orientation on Course Content - Overview & Planning – This live class will also be used for Q and A
- 1st Oct – Project Teams formed and team charter delivered
- 25th Oct – Mid Term CR1 Essay due-midnight (post on BB)
- 1st Nov 2018 – CR1 Self Critique Video Due
- 30th Nov 2018- Project team (video optional) PPT presentations - optional live class
- 3rd Dec 2018- Final CR2 Essay due midnight (post on BB)
- 14th Dec 2018 – Submission of team report (word, PDF and physical hardcopy)

Part I – Innovation in Context

Week 1 – 10th Sept 2018: Mod 0 & 1 Orientation, instructor background, syllabus overview, & assignments.
- Overview of the entire course
- Grading structure (Critical Reviews, Book Review, Discussions, Projects)
- Web site layout and operation
- Project team formation and operation – Review past projects
- Critical Thinking and Performance Rubric
- Course Value in Career Planning – Levels of Management Thinking

Week 2 –: Mod 2 Dimensions of Innovation

- Global market trends
- Sources of Innovation (internal and external)
- Types of innovation – product, process, organizational, and business model
- Innovation environments – manufacturing, service, public sector
- Degrees of Innovation Disruptive, Radical, incremental

Mod 2: Special Video Lectures
- 2.1 Innovation Lifecycle (29mins)
- 2.2 Circle of Innovation Tom Peters (37mins)
- 2.3 History of Innovation (9 mins)
- 2.4 Business Model Innovation (41 mins)
- 2.5 Social Economic Innovation (20 mins)
- 2.6 Process Innovation (27 mins)
- 2.7 Product Innovation (32 mins)
- 2.8 Service Innovation (38 mins)
Week 3 – Mod 3 Diffusion of Innovation

- Introduction to Social Evolution and Innovation
- Introduction to the History of Engineering and societal impact
- Diffusion of Innovation theory

Part 2 – Developing an Innovative Enterprise

Week 4: - Mod 4 Designing and developing an Innovative Lean Enterprise through Business Transformation (Sustaining: Chapter 1,2)

- What is transformational change?
- What is an Innovative Enterprise?
- How do we design and develop it?
  - Directional planning and future state visioning
  - Business process Analysis
  - Business process design and infrastructure alignment

Mod 4 Specialty Video Lecture

- 4.1 Knowledge Management

Week 5 – Mod 5 Organizational Approach to Cultural Transformation (Sustaining: Chapter 3)

- Building an innovative culture
- Motivating teams and individuals
- Recognizing and overcoming systemic barriers
- Understanding organizational politics
- Fostering organizational learning
- Roles and responsibilities in a transformation project

Mod 5 Specialty Video Lectures

- Video 5.1 Leadership in Innovation (44 mins)
- Video 5.2 Innovation Org Structure and Systems (22 mins)
- Video 5.3.1 Case Study Food Company (18 mins)
- Video 5.3.2 Case - Organize for ERP Business Transformation (13 mins)
- Video 5.5 -Skills for the Future Organization - This a series of 6 document capture video presentations as follows:
  - Video 5.5.1 Five Future Organization Trends (11 mins)
  - Video 5.5.2 Seven Principles of Future Employees (14 mins)
  - Video 5.5.3 Evolution of the concept of Employee (6 mins)
  - Video 5.5.4 Ten Principles of Future Manager (10 mins)
  - Video 5.5.5 14 Principles of Future Organization (17 mins)
  - Video 5.5.6 Bloomberg Survey Competencies (4 mins)

Part 3 – Building the Lean Innovation Management Process
Week 6 – Mod 6 Enterprise Integration and Process Management  
(Eng & Product: Chap 1,2,3)

- Enterprise wide process modeling and the supply chain
- New product development in various environments – the use of the stage gate method
- Systems engineering approach applied to enterprise process integration
- Process and workflow analysis
- Design and Systems thinking

Mod 6 Specialty Videos Lectures

- Video 6.1.1 BAE Systems Enterprise Business Assessment (20 mins)
- Video 6.1.2 BAE Systems Enterprise Business Scenarios (6 mins)
- Video 6.2.1 Lockheed Martin Business Assessment (11 Mins)
- Video 6.2.2 Lockheed Martin Overarching Engineering Process Architecture (8mins)

Week 7 – Mod 7 Integrating Process, Project, Programme Management & IPT’s  
(Eng & Product Chapters 4, 5, 6)

- Roles and responsibilities in a process driven enterprise
- Programme and Project Management in a Process Driven Enterprise
- Concurrent engineering and collaborative product development concepts
- Effective Integrated Project team (IPT’s)

Mod 7 Specialty Videos

- Video 7.1 Voice of the Customer
- Video 7.2 Product Lifecycle Management

Week 8 – Mod 8 Lean Product Development & Knowledge  
(Eng & Product Chapt 7,8,9,10,11)

- Deliverables Architecture and Knowledge Management
- Rules and Set based Product Development
- Programme structuring and planning
- Risk management
- Project initiation and execution
- Engineering change and programmed reviews

Specialty Video Lectures

- Video 8.1-Case Study Setting The Enterprise Baseline (34mins)
- Video 8.2-Case Study - Analyzing As Is Process (12mins)
- Video 8.3-Case Study Design To Be Enterprise (19mins)
- Video 8.4-Supplemental Tools (11mins)

Week 9 – Mod 9 Deploying & embedding the innovation process  
(Eng & Product Chap 12, 13)

- Management of Change
- Organizing for deployment
- Overcoming resistance to change
Role of an external management consultant as facilitator, coach and change agent

Specialty Video Lecture
- Video 9.1 Accelerating Change (1 Hr)

**Part 4 - Sustaining the Innovative Lean Enterprise**

**Week 10** – Mod 10 Continuous Analyses of “As Is” / “To Be” Business Process (Sustaining Chapter 4)
- Researching customer needs
- Selecting and Prioritizing Issues
- Defining / designing Processes – Value Stream Mapping
- Establishing standards and performance measures
- Setting objectives for improvement

Specialty Video Lectures
- Video 10.1 Globe and Mail Case Study (53 mins)

**Week 11** – Mod 11 Continuous Improvement through Structured Problem Solving (Sustaining Chapter 5)
- Problem Identification
- Root Cause analysis
- Data gathering an root cause analysis
- Problem Solving Tools and Techniques
- Formulating and selecting alternative solutions
- Documentation and implementation

**Advanced Modules (Optional) – More in Depth**

Module 13 - Product Innovation Management
Module 14 - Final Team Project Management and Development
Module 15 - Innovation Dynamics and Industrial Change
Module 17 - Knowledge Management
Module 18 - Leadership and Management for Innovation
Module 19 - Product Lifecycle Management
Module 20 - Business Process Management and Innovation
Module 21 - Fuzzy Front End and New Product Development
Module 22 - Social Evolution and Diffusion
Module 23 - Foresight Management and Development
Module 24 - Innovation Drivers & Sources
Module 25 - Innovation Drivers By Industry
Module 26 - Innovative Nations & National
Module 27 - Innovation Gurus & Innovative Companies
Module 28 - Types of Innovation – Case Studies
Module 29 - Technology Management and Innovation
Module 30 - Innovation in Consulting
Module 31 - Innovate Frameworks
Module 32 - Global Market Trends & Management of Global Change
Module 33 – Socio-Political Management